Characteristics of the St. Marys Bay Lobster Stock in Relation to Scallop Gear Impact

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CHARACTERISTICS OF THE ST. MARYS BAY LOBSTER STOCK IN RELATION TO SCALLOP GEAR IMPACT

by

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ABSTRACT

Robichaud, D. A., A. M. Williamson, and D. E. Graham. 1987. Characteristics of the St. Marys Bay lobster stock in relation to scallop gear impact. Can. MS Rep. Fish. Aquat. Sci. 1955: iv + 17 p.

An assessment of the impact of scallop fishing on the lobster fishery in St. Marys Bay, N.S. was undertaken to help alleviate a conflict that recently arose between the two fisheries. A diving survey undertaken during July 1986 showed that relatively high lobster densities (111 lobsters/1000 m²) occurred on rough, rocky bottom where no scallops were found. Lobsters at lower densities (2.5-15 lobsters/1000 m²) co-occurred with scallops on mud bottom interspersed with a few rocks. Although scallop density in the whole area surveyed was low (57.8 scallops/1000 m²), the animals were large (78% ≥ 120 mm shell height). Tagging results showed that the majority (91%) of recaptured (82) lobsters remained in St. Marys Bay and that the average straight-line distance traveled by mature females was significantly ($p < 0.01$) greater (35 km) than for both mature males (16 km) and immature lobsters (12 km). Sales slip analysis showed that annual lobster landings and catch rates increased markedly between 1978 and 1986. Size-sex frequency distributions were obtained from 5152 lobsters caught at different locations inside St. Marys Bay with commercial traps and an experimental Rockhopper trawl. Although lobster fishing occurred in most of the Bay, dragging for scallops took place in <7% of the Bay in areas of low lobster density. The data suggest little adverse impact on lobsters by scallop dragging in St. Marys Bay.

RÉSUMÉ

Robichaud, D. A., A. M. Williamson, and D. E. Graham. 1987. Characteristics of the St. Marys Bay lobster stock in relation to scallop gear impact. Can. MS Rep. Fish. Aquat. Sci. 1955: iv + 17 p.

L'impact que la pêche aux pétoncles peut avoir sur la pêche aux homards fut evalué dans la baie St. Marys pour aider à résoudre un conflit qui est apparu récemment entre ces deux pêcheries. Une étude, accomplit à l'aide de plongeur, en juillet 1986 a démontré que les concentrations de homards étaient relativement plus élevées (111 homards/1000 m²) sur les fonds rocheux où aucun pétoncle était présent, et que les deux espèces cohabitaient sur des fonds de vase mélangés avec quelques roches où les densités de homard étaient relativement basses (2.5 à 15 homards/1000 m²). Malgré que la densité des pétoncles dans ces mêmes endroits était peu élevée (57.8 pétoncles/1000 m²) ils étaient de grande taille (78% > 120 mm). Des résultats de marquage ont démontré que la majorité (91%) des homards recapturés (82) ont demeuré dans la baie St. Marys, et que la distance moyenne, en ligne droite, parcourue par les femelles matures était significativement ($p < 0.01$) plus longue (35 km) que les mâles matures (16 km) et que les homards immatures (12 km). L'analyse des récépissés d'achat a démontré que les prises annuelles ainsi que les taux de capture avaient augmenté de façon prononcés entre 1978 et 1986. Des distributions de fréquence de taille et sexe ont été obtenu à partir de 5152 homards capturés à différents endroits à l'intérieur de la baie St. Marys avec des cassiers commercials et avec un chalut "Rockhopper" expérimental. Malgré que la pêche aux homards avait lieu à travers tout l'ensemble de la baie, la pêche aux pétoncles avait seulement lieu dans <7% de la baie, dans des endroits où les densités de homard étaient moins elevées. Les donées suggèrent que le dragage de pétoncle, à peu d'impact adverse sur les stocks de homard dans la baie St. Marys.

INTRODUCTION

Conflicts between scallop draggers and lobster fishermen have developed in various Canadian Maritime locations, due, in part, to declining scallop stocks (Jamieson and Campbell 1985) resulting in fishing of marginal scallop grounds that overlap traditional lobster fishing grounds. Lobster fishermen are concerned about the negative impact that scallop dragging might have on lobsters and their habitat. In response to lobster fishermen's complaints about conflict between scallop, Irish moss and lobster fishing, several studies were undertaken near Prince Edward Island (P.E.I.). These impact studies included the monitoring of incidental lobster bycatch in the scallop fishery (Pringle and Jones 1980) and underwater observations of scallop drags (Scarratt 1975; Jamieson and Campbell 1985). The studies indicated that scallop dragging had a minimal impact on lobster stocks, mainly because there was little overlap between commercial concentrations of the two species. Despite these studies, lobster fishermen in St. Marys Bay, Nova Scotia, were so concerned about damage to their lobster stock that in 1985 the Department of Fisheries and Oceans temporarily closed the scallop fishery pending an impact assessment. The fishermen argued that past studies were done in a different habitat in Northumberland Strait, and that the results were not necessarily applicable to their lobster grounds.

The purpose of the present study is to estimate the severity of the conflict in St. Marys Bay by: 1) determining the distribution of catch and effort of the lobster and scallop fishery in St. Marys Bay; 2) estimating scallop and lobster densities and distribution in local areas using SCUBA and 3) determining the movement of tagged lobsters in St. Marys Bay.

MATERIALS AND METHODS

The area studied included St. Marys Bay northeast of a line from the southwestern tip of Brier Island across to Meteghan (Fig. 1).

LOBSTER MOVEMENT

Lobsters were tagged in the northern half of St. Marys Bay in September 1978, prior to the lobster fishing season. One hundred and eighty-one traps were hauled and the size, sex and shell condition of 637 lobsters were recorded (Ennis 1977). Four hundred and ninety-one legal-size lobsters (>81 mm carapace length (CL)) were tagged with FLT-69 Floy tags and released in the same area of capture (Fig. 2). All returned tags were recovered within an 8-mo time period ending May, 1979 (the end of the 1978-79 lobster fishing season). Lobsters were categorized as immature (81-94 mm CL) and mature (≥95 mm CL) based on the median size at 50% physiological maturity (Campbell 1983a). A t-test analysis was used to compare the mean distances travelled between sexes and maturity groups. No information was available on growth, but information on size distribution and catch rate is presented.

ST. MARYS BAY COMMERCIAL LOBSTER FISHERY FOR 1986

Lobster size distribution and catch rate data were collected on board different commercial lobster fishing boats fishing inside St. Marys Bay during May 1986 (the latter part of the 1985-86 lobster fishing season which began the last Monday of November and ended May 31) and during December 1986 (the beginning of the 1986-87 lobster fishing season). A total of 1562 traps were hauled and the size, sex and shell condition of 3345 lobsters were recorded. Bottom and surface temperatures were also noted.

To obtain quantitative information on injuries to lobsters, possibly caused by dragging for scallop or fish in St. Marys Bay, 1505 lobsters were examined for any injuries or missing claws during the December 1986 sea sampling.

UNDERWATER OBSERVATIONS

In the northern half of St. Marys Bay, lobster and scallop densities were estimated on various bottom types after a preliminary SCUBA diving survey in July 1986. A total of 4805 m^2 of bottom area was surveyed by divers swimming along a 50-m transect line (Fig. 3). All lobsters and scallops found within 1 m of either side of the transect line were collected and bottom types were determined by observation. Densities of lobsters and scallops per square meter was multiplied by 1000 and expressed as the number of animals per 1000 m^2 (No./1000 m^2). Collapsible corrals were used for sampling a 15-m^2 area at dive site 5 (Fig. 1). However, this method was judged not practical and was not used in any of the other locations. Size, sex and shell condition of lobsters, shell length of scallops and bottom temperatures were recorded at each dive site.

ROCKHOPPER TRAWL SURVEY

Lobster data were obtained as bycatch during an inshore gadid survey in St. Marys Bay (August 1986) with a 286 Rockhopper trawl (19.5 m footrope; 140 mm mesh with 13 mm mesh liner). Fifteen 20-min tows at 3 knots were made throughout St. Marys Bay (Fig. 4). The bottom area covered during each tow was estimated as the product of distance travelled and the trawl width (19.5 m). Lobster densities were calculated as the number of lobster caught per 1000 m^2 (No./1000 m^2). Lobster size, shell hardness, sex and bottom temperatures were recorded.

SALES SLIP ANALYSIS

Sales slips, gathered by the Department of Fisheries and Oceans, Statistics Division personnel, provided landings by individual fishermen in each port for 1978-86. Each sales slip represented a day that lobsters were sold by an individual fisherman. The mean catch per unit effort (CPUE) for fishermen fishing within St. Marys Bay was determined by dividing total annual catch (kg) by the total number of sales slips (kg/sales slip). This method of calculating daily effort and CPUE could be biased as some fishermen do not sell their catch daily. However, the data is accurate when calculating yearly landings.

RESULTS

LOBSTER MOVEMENT

Eighty-two (17%) of the tagged lobsters were recaptured. Most (91%) were captured inside St. Marys Bay (Fig. 2) within an 8-mo period. Eight (2%) were captured after May 1979. One of these, a male (133 mm CL), at large for 253 d, was caught on the southwest side of Browns Bank (Lat. 42°36', Long. 66°05'), a straight line distance of 211 km. Another male (118 mm CL), at large for 968 d, was caught off Seal Island, N.S., (Lat. 43°23', Long. 66°02'), 122 km from the release site. In contrast, four male lobsters (92, 97, 105 and 110 mm CL) were caught a mean distance of 8 km (2-13 km) from the release sites after being at large for 967-970 d.

The mean distance moved by mature males (16 km) was not significantly different ($p < 0.01$) from the mean distance travelled by immature lobsters (12 km). Mature females moved significantly ($p < 0.01$) further (35 km) than mature males and immature lobsters.

Most lobsters travelled in a southwestward direction (due to the physiographic constraints of St. Marys Bay) from the release sites and a few lobsters travelled between release sites (Fig. 2). The release sites were close together in the northern part of the bay and all lobsters were only recaptured once. The study design didn't allow for detection of movement into the Bay or for seasonal movement in and out. However, the tagging study does show that most lobsters (91%) remained inside the Bay during the 8-mo period.

SIZE FREQUENCIES

Lobster size distributions obtained off various ports inside St. Marys Bay have shown that the mean CL of lobsters caught with traps during May and December 1986 was smaller than the mean CL of male and female lobsters caught with traps in September 1978 and those caught with the Rockhopper trawl in August 1986 (Fig. 5, 6, 7, 8; Table 1). In all samples the mean size of males was always larger than that of females. The percentage of legal-size animals in the catch during May (24%) and December (41%) 1986 were lower than the percentage of those caught during September 1978 (77%) and August 1986 (63%) (Table 1). The sex ratio for immature lobsters was 1:1 (M:F) during all sampling periods but varied for mature lobsters (>81 mm CL) from 3.7:1, 3:1, 4.2:1 and 2:1 (M:F) during May and December 1986, September 1978 and August 1986, respectively (Table 1).

DIVING SURVEY

The diving survey undertaken during July 1986 revealed diverse biological and physical differences between locations across the northern half of St. Marys Bay (Fig. 3, Table 2). A total of 55 lobsters was collected, and only 15 were commercial size (≥81 mm CL) (Fig. 9). Because of the small sample size, no interpretation of the size frequency distribution can be made. For analysis, dive sites were grouped according to bottom types into six different areas (Table 2).

Firstly, an area situated on Mink Cove shoal (Fig. 1) was the only area surveyed on which both lobsters and scallops were found (Dive sites 1, 4, 6, 7, 14, 15, 17 and 18) (Fig. 3, Table 2). The bottom was covered with mud, interspersed with a few rocks of various sizes. The mean density of lobsters in the area was estimated at 6.8 lobsters/1000 m² (2.5 to 15 lobsters/1000 m²) (Table 2). On the same grounds, 164 large scallops (78% > 120 mm shell height (SH)) were collected (Fig. 10). The mean density of scallops found on Mink Cove Shoal was estimated at 57.8 scallops/1000 m² (5 to 180 scallops/1000 m²) (Fig. 3, Table 2).

Secondly, an area situated in the upper part of St. Marys Bay was characterized by deep mud (Dive sites 12 & 13) (Fig. 3, Table 2). The mean lobster density in the area was estimated at 5 lobsters/1000 m².

A third area, situated on St. Marys Shoal (Dive sites 9 and 10) (Fig. 3, Table 2), was characterized by a sandy gravel bottom interspersed with large boulders and large kelp attached to fist-sized rocks which could be carried with the current. Lobster density in the area was estimated at 10 lobsters/1000 m².

A fourth area, situated on the western side of St. Marys Bay near Little River and Sandy Cove, was covered with many large boulders and piles of large rocks covered with large kelp. This habitat provided excellent lobster shelter (Dive sites 5, 8 and 11; Fig. 3, Table 2). Lobster densities were estimated at 111 lobsters/1000 m² and 266.7 lobsters/1000 m² with transect line and corral method, respectively.

A fifth area, situated on the eastern side of St. Marys Bay, was covered with a sandy substrate interspersed with a few rocks and patches of kelp (Dive sites 2 and 3) (Fig. 3, Table 2). The lobster density in this area was estimated at 10 lobsters/1000 m².

The last area surveyed was situated on the same side of St. Marys Bay (Dive site 16) (Fig. 3, Table 2). However, the substrate consisted of ledge rocks covered by Desmarestia spp. No kelp was found but large sea urchins ($\bar{X}$ = 73.2 mm shell width, SE = 3.1) were present in densities estimated at 660 urchins/1000 m². The lobster density was estimated at 30 lobsters/1000 m².

ROCKHOPPER TRAWL SURVEY

Lobster densities estimated using the Rockhopper trawl (Fig. 4, Table 3) were much lower than those determined during the diving survey (Fig. 3, Table 2). Eleven hundred and seventy lobsters were caught in an estimated bottom area of 560,079 m² (Table 3). The overall lobster density was estimated at 2.1/1000 m² (Table 3) compared with an overall density of 11.5 lobsters/1000 m² (Table 2) estimated during the diving survey. A direct comparison of the two sampling techniques may not be justified, since the trawling was done in the southern two-thirds of the Bay (Fig. 4), and the diving in the northern half of the Bay (Fig. 3).

CATCH EFFORT ANALYSIS

Since 1978, St. Marys Bay lobster landings have increased (Fig. 11). Little River, which recorded a slight decrease in landings for 1985/86, had a marked increase between 1978 and 1984. Ports in the Bay of Fundy, however, Whale Cove and Digby for

example, varied little during this period (Fig. 11). Catch rate data expressed as kilograms per boat per day also showed a general increase for the same period (Fig. 12). However, lobster catch rates from Tiverton had slightly decreased between the 1984-85 and 1985-86 lobster fishing seasons. Similar decreases occurred at Whale Cove and Digby (Fig. 12).

Catch per unit effort data expressed as kilograms per trap hauled (CPUE) was 0.27 kg/trap hauled (in 844 trap hauls) for May 1986, compared to 0.54 kg/trap hauled (in 718 trap hauls) for December 1986 (Table 1). A high CPUE of 2.25 kg/trap haul (in 181 trap hauls) was observed during September 1978, but this sampling occurred prior to the fall lobster fishing season, and just following the summer molt, hence a comparison is unjustified.

LOBSTER INJURIES

Close to shore, in shallow water, where no dragging is possible because of rough bottom, only 3% (out of 607 lobsters sampled) of sublegal-size lobsters (<81 mm CL) and 3% (out of 417 lobsters sampled) of legal-size lobsters (≥81 mm CL) had scar tissue. In the deeper water area where dragging could have occurred, 16% (out of 284 lobsters sampled) of sublegal size lobsters, and 24% (out of 197 lobsters sampled) of legal-size lobsters, had scar tissue.

BOTTOM TEMPERATURES

Bottom temperatures varied with depth and season. Warmer bottom temperatures (11.2-16.5°C) recorded during summer were similar for the month of July and August 1986 and decreased slightly with increasing depth (Fig. 13). Colder bottom temperatures (6.3-8.0°C) recorded during May and December 1986 were similar but did not change according to depth (Fig. 13).

DISCUSSION

Although preliminary results of this study provide an understanding of the relative distribution and densities of both lobsters and scallops in St. Marys Bay, lobster abundance on scallop grounds in St. Marys Bay could be influenced by seasonal lobster migrations. The 1978 tagging study in the northern part of St. Marys Bay shows evidence of outward movement, but the release design does not allow for study of inward movement (Fig. 2). Other tagging studies undertaken yearly between 1944-80 off Port Maitland showed movement in a northeasterly or southeasterly direction along the Nova Scotia coastline (Campbell 1982; Campbell and Stasko 1985). Several tagged lobsters released off Port Maitland were captured inside St. Marys Bay (Campbell 1982). The St. Marys Bay tagging study showed that mature females moved significantly greater distances than immature and mature male lobsters. Similar results were obtained during a tagging study in the Bay of Fundy (Campbell and Stasko 1986).

Lobster size-frequency distributions were predominantly influenced by the proportion of first molt into legal size lobsters. The higher proportion of legal size lobsters found in August 1986 (63%) and September 1978 (77%) was the result of the summer molt. The decrease in percentage of legal size lobsters for December (41%) and May 1986 (24%) was due to a reduction in the number of first molt lobsters caused by intense fishing pressure. In all size frequencies, the mean size was slightly larger for males than females. This was probably due to a higher growth rate of males after sexual maturity (Campbell 1983a).

The sex ratio of immature lobsters in St. Marys Bay was 1:1 (M:F). Similar sex ratios were found for immature lobsters in the Bay of Fundy (Campbell 1986) and in southwestern Nova Scotia (Campbell and Pezzack 1986). However, for mature animals, males were always present in larger numbers than females during all seasons. This differs from a Bay of Fundy study which showed that the percent of mature females increased during summer after the arrival of berried females in shallow, warmer water and decreased during winter after their departure toward deeper water (Campbell and Stasko 1986).

The effects of scallop dragging on lobster injury could be minimal during summer since lobsters are more active at higher water temperatures (McLeese and Wilder 1958). However, a reduction in lobster mortality (caused by dragging) during summer could be offset by the presence of soft-shell lobsters which could be less mobile than hard-shell lobsters. The molting period in the Bay of Fundy usually occurs in mid-August to late October (Campbell 1983a) and between June and November in Port Maitland area (Wilder 1953). Only 3% of the lobsters found in St. Marys Bay during July and August 1986 were soft shelled. However, the percentage of soft-shell lobsters present during the summer will vary with the mean summer bottom temperature (Campbell 1983b).

Bottom substrate type alters the impact of scallop dragging on lobsters. In previous studies done in the Northumberland Strait, Scarratt (1975) and Pringle and Jones (1980) found that exposed lobsters on flat mud, gravel or sandstone tended to avoid moving drags. Most gear-induced damage resulted when lobsters in burrows were hit or crushed by rocks disturbed by dragging on rockier bottoms (Scarratt 1975; Pringle and Jones 1980). According to the diving survey in the northern half of St. Marys Bay, scallops were only found on muddy type bottom where lobster densities were relatively low. Areas of high lobster abundance were located on rocky bottom where no scallops were found and where scallop dragging was impractical. Although 7% of lobster grounds were fished by scallop draggers (Fig. 1, shaded area), the overlapping probably occurs in areas of lower lobster concentration similar to Mink Cove shoal, thus reducing any impact that scallop dragging might have on lobsters. The high percentage (16-24%) of injured lobsters in the catch cannot be attributed to scallop dragging alone. Fish draggers also fished in the same general area, and a certain percentage of injuries could be attributed to handling of sublegal lobsters by lobster fishermen (Scarratt 1973; Krouse 1976)..

CONCLUSION

The intensity and duration of scallop dragging will depend on the densities and distributions of scallops throughout St. Marys Bay. To substantiate any decision as to a scallop fishing season inside St. Marys Bay, further studies are needed to increase our knowledge of the seasonal distribution

and densities of lobsters and scallops in the southern half of St. Marys Bay where most scallop dragging has occurred. Lobster landing trends in St. Marys Bay have not shown any evidence of decline during the past 8 yr. The present study suggests that in St. Marys Bay there is no detectable impact on lobster stocks by the dragging for scallops. The traditional lobster and scallop fisheries have little overlap due to the tendency for commercial abundances of both species to occupy different types of ocean bottom. This is similar to findings made in other studies carried out in the southern Gulf of St. Lawrence (Scarratt 1975; Jamieson and Campbell 1985).

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Table 1. Statistics on lobsters obtained from at-sea sampling in St. Marys Bay.

Date	Ports sampled	No. of traps hauled	Total no. of lobsters	% of lobsters <81 mm CL	% of lobsters ≥81 mm CL	Sex ratio Immature (<95 mm) M : F	Sex ratio Mature (≥95 mm) M : F	kg/ trap haul (≥81 mm CL)	No./ trap haul (≥81 mm CL)	No./ trap haul (<81 mm CL)	$\bar{X}$ CL (mm) for total lobsters measured M	$\bar{X}$ CL (mm) for total lobsters measured F
May/86	Sandy Cove	202	331	76	24	1.3:1	27.0:1	0.27	0.40	1.24	80.6	74.4
	Little River	127	288	81	19	1.0:1	1.8:1	0.25	0.43	1.83	75.9	74.8
	Comeauville	300	745	72	28	0.9:1	2.6:1	0.40	0.70	1.78	79.2	76.9
	Tiverton	215	294	84	16	1.0:1	2.3:1	0.12	0.20	1.15	76.7	75.2
May/86	Total	844	1658	76	24	1.0:1	3.7:1	0.27	0.46	1.50	78.5	75.8
Dec./86	Little River	379	910	58	42	1.2:1	3.0:1	0.55	1.00	1.39	79.3	76.5
	Tiverton	339	777	60	40	1.0:1	2.5:1	0.53	0.91	1.38	81.5	78.3
Dec./86	Total	718	1687	59	41	1.1:1	2.7:1	0.54	0.96	1.39	80.3	77.3
Sept./78	Weymouth North	181	637	23	77	1.5:1	4.2:1	2.25	2.71	0.81	95.2	87.5
Aug./86	Rockhopper Trawl	-	675	37	63	0.9:1	2.0:1	-	-	-	87.2	83.2

Table 2. Sampling statistics collected by divers during July 1986 in St. Marys Bay.

Dive sites	Surface area sampled m^2	No. of lobsters (no. lobsters/1000 m^2)	Lobster carapace length, mm (min.-max.)	No. of scallops (no. scallops/1000 m^2)	Depth m	Bottom type
1	100	1(10)	67	18(180)	14	Mud bottom
2	100	-	-	-	6	Sandy and some kelp
3	200	3(15)	58-77	-	6)	Sandy, eel grass, desmarestia
					)	and kelp
4	600	4(6.7)	44-75	52(86.7)	15	Mud, few rocks
5	15	4(266.7)	52-87	-	9	Many big rocks and kelp
6	600	5(8.3)	30-93	20(33.3)	18	Mud, few rocks
7	200	3(15.0)	77-123	4(20.0)	21	Mud, few rocks
8	30	4(133.3)	46-72	-	9	Many big rocks and kelp
9	300	3(10.0)	60-108	1(3.3)	8)	Large kelp attached to mobile
10	400	4(10.0)	61-135	-	9)	fist-size rocks interspersed by
					)	large bolders on sandy bottom
11	60	6(100.0)	52-76	-	8	Kelp and many big rocks
12	400	3(7.5)	56-75	-	15	Mud with lobster tunnels
13	200	-	-	-	8	Mud
14	400	1(2.5)	93	23(57.5)	15	Mud
15	200	2(5.0)	44-57	13(65.0)	15	Mud, few rocks
16	300	9(30.0)	43-127	1(3.3)	8	Ledge rocks with desmarestia
17	300	1(3.3)	63	30(100.0)	18	Mud, few rocks
18	400	2(5.0)	83-91	2(5.0)	18	Mud
Total	4805	55(11.5)	30-135	164(34.1)	6-18	

Table 3. Statistics on lobster caught with the Rockhopper trawl inside St. Marys Bay during August 1986.

Tow #	Lobster (kg)	No. lobsters	Speed in knots (5.560 km/h)	Duration (min)	Distance covered (m)	Surace area sampled (m^2)	No. lobsters/ 1000 m^2	Depth (m)
1	47	98	3	20	1853	36134	2.71	9
2	0.5	4	"	"	"	"	0.11	27
3	58	100	"	"	"	"	2.77	7
4	32	31	"	"	"	"	0.86	18
5	24.5	56	"	"	"	"	1.55	9
6	21.5	35	"	30	2780	54210	0.65	13
7	-	-	"	20	1853	36134	-	22
8	5.25	11	"	"	"	"	0.30	33
9	11.25	18	"	"	"	"	0.50	22
10	21	36	"	"	"	"	1.00	37
11	402	595[1]	"	"	"	"	16.47	9
12	24	38	"	"	"	"	1.05	9
13	7	7	"	"	"	"	0.19	33
14	85	138	"	"	"	"	3.82	29
15	6	3	"	"	"	"	0.08	37
Total	745	1170	3	310	28722	560079	2.09	-

[1]Estimated number of lobsters extrapolated from size/weight relationship of a subsample of 100 lobsters that were measured.

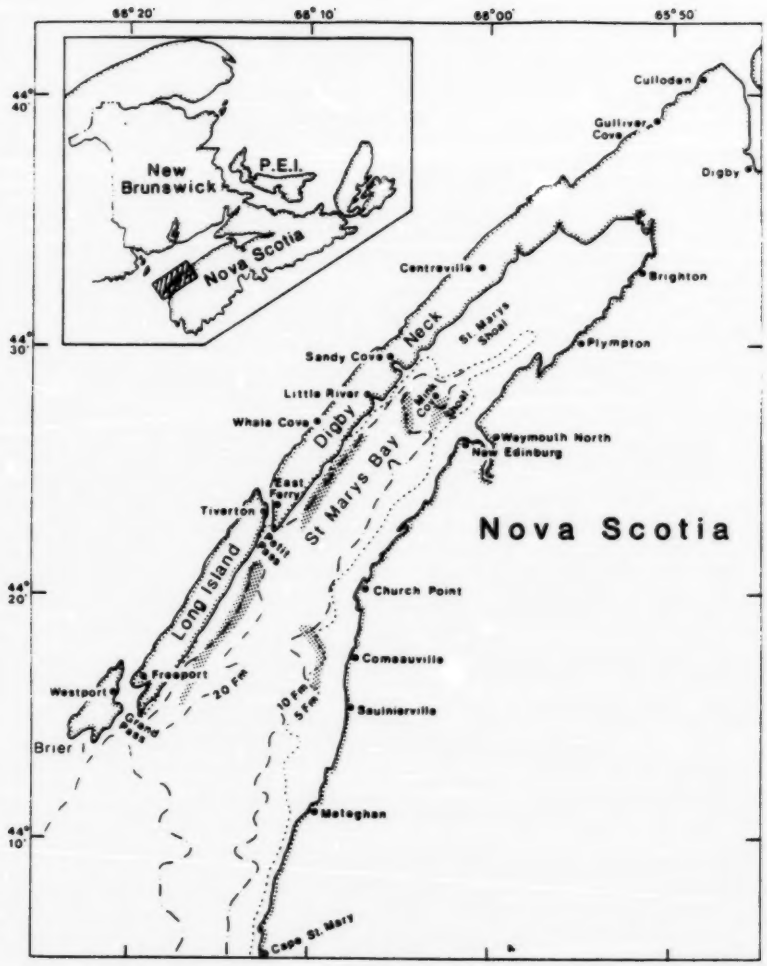

Fig. 1. Map showing the locations of different lobster fishing ports inside St. Marys Bay and surrounding areas (shaded area shows location where scallop fishing has occurred).

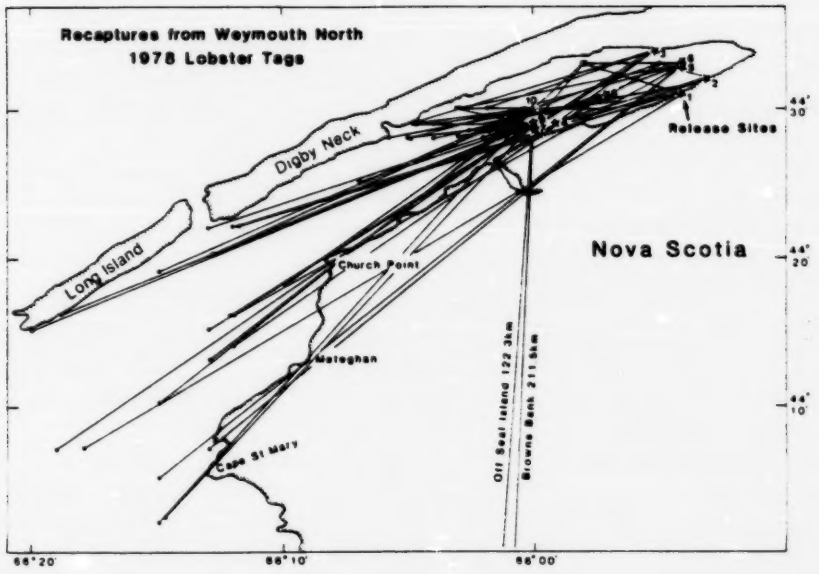

Fig. 2. Map of release and recapture points with apparent straight-line distances traveled for all tagged lobsters captured in St. Marys Bay and surrounding areas during the 1978-79 fishing season.

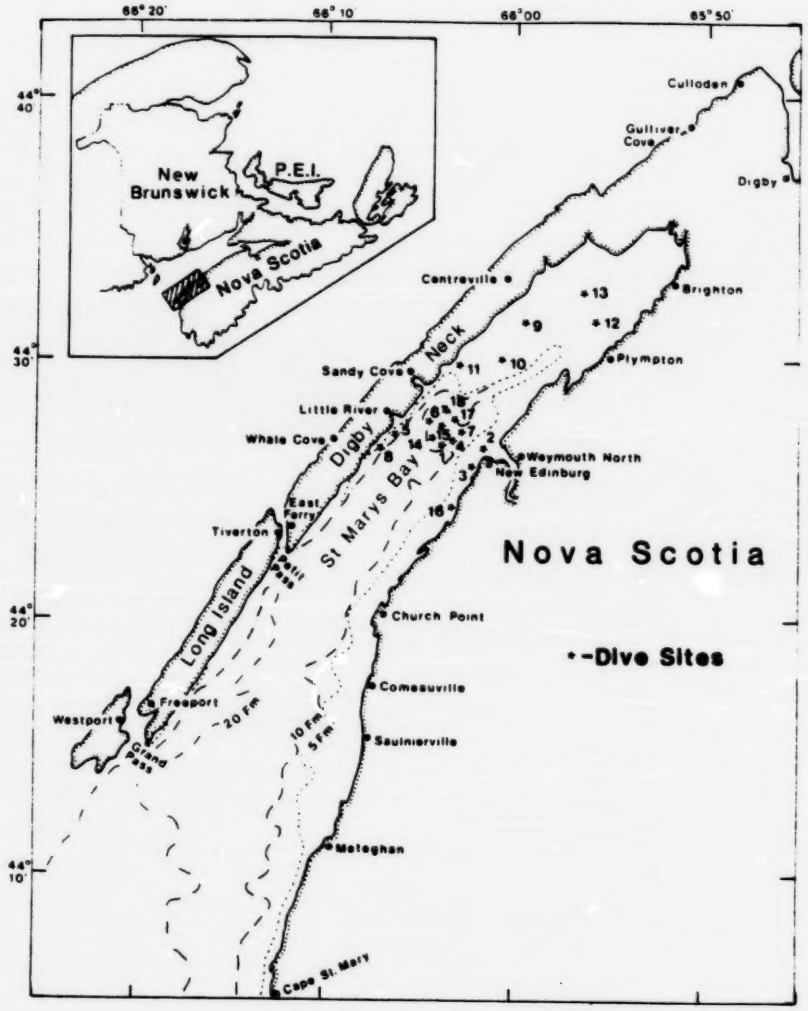

Fig. 3. Distribution of July 1986 dive sites inside St. Marys Bay.

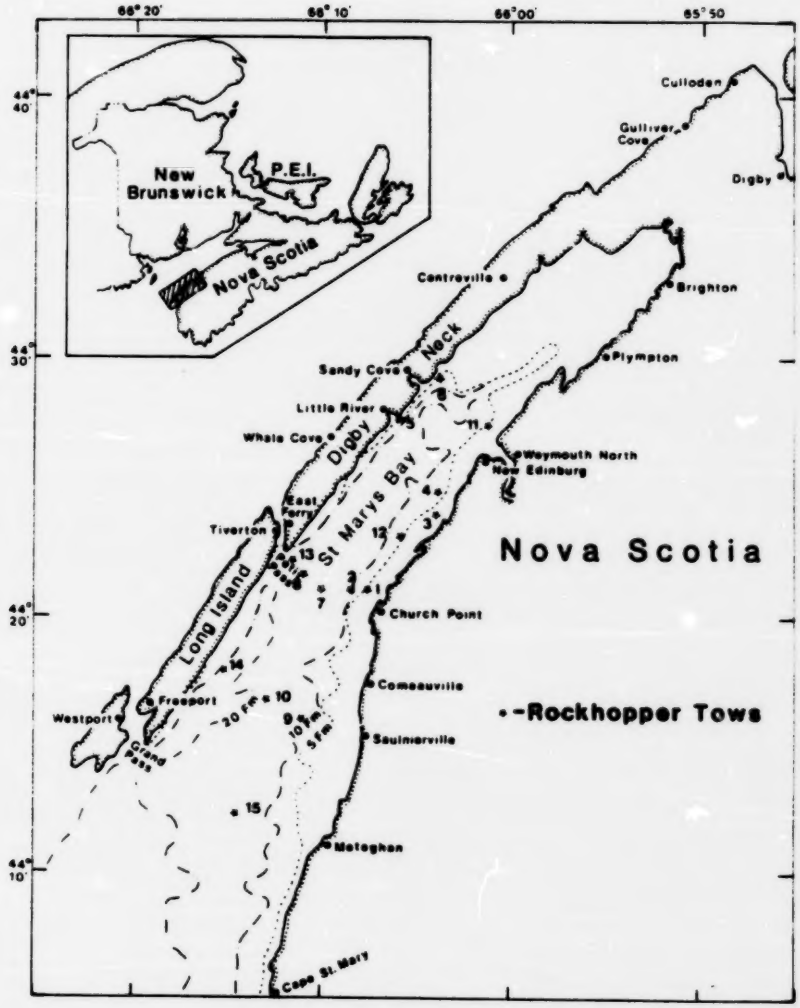

Fig. 4. Map showing the location of tows made with a Rockhopper trawl during August 1986.

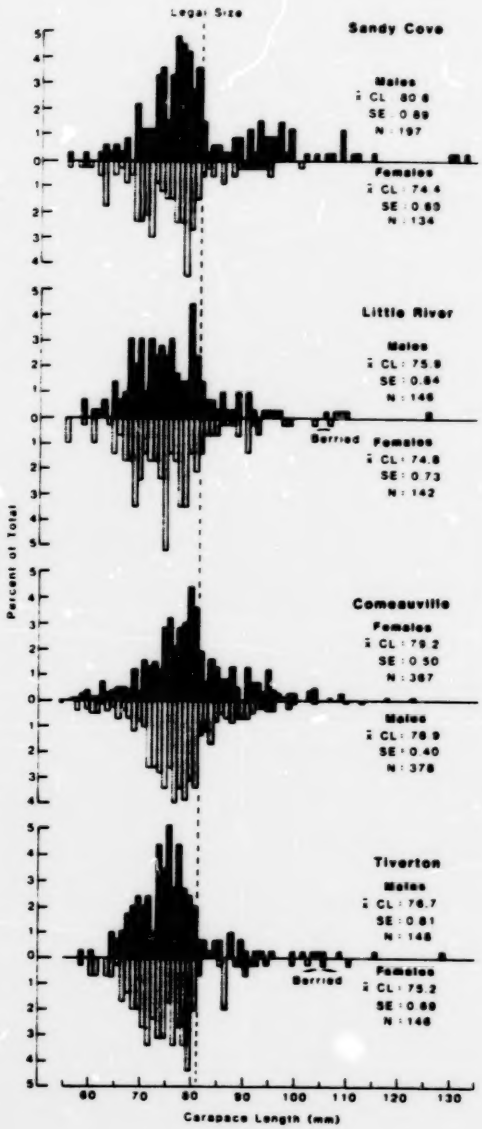

Fig. 5. Size frequencies (% in 1-mm CL groups of total sample) of trapped male and female lobsters for four fishing ports in St. Marys Bay during May 1986. (X̄CL = mean carapace length; SE = standard error, N = number of individuals).

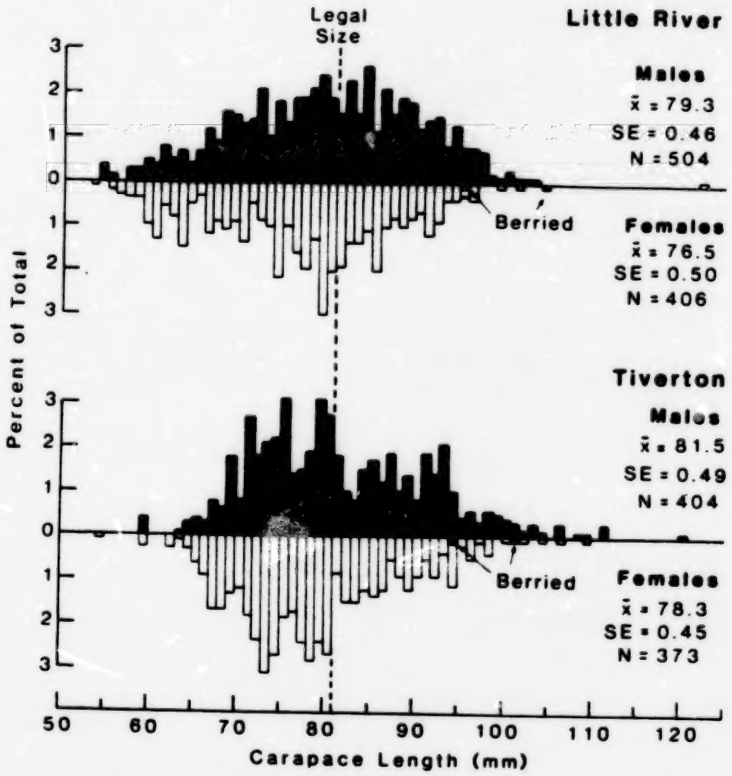

Fig. 6. Size frequencies (% in 1-mm CL groups of total sample) of trapped male and female lobsters for two fishing ports in St. Marys Bay during December 1986. (x̄CL = mean carapace length; SE = standard error; N = number of individuals).

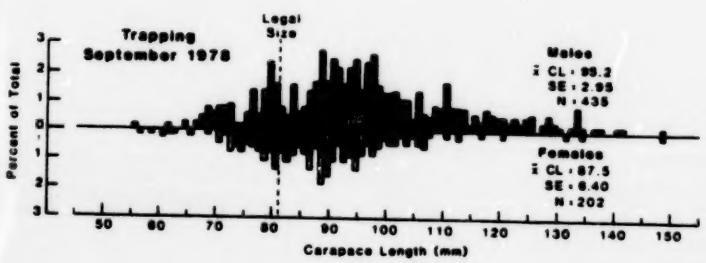

Fig. 7. Size frequencies (% in 1-mm CL groups of total sample) of male and female lobsters caught in fishermen's traps off Weymouth north in September 1978. (x̄ = mean carapace length; SE = standard error; N = number of individuals).

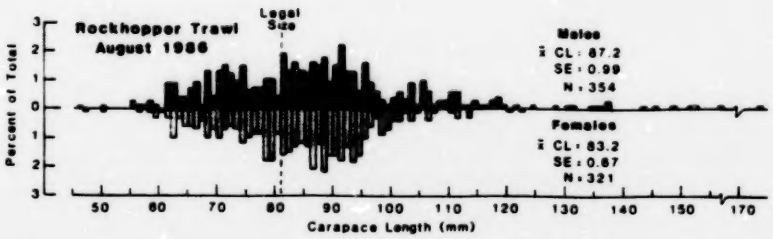

Fig. 8. Size frequencies (% in 1-mm CL groups of total sample) of male and female lobsters caught with the Rockhopper trawl in the southern half of St. Marys Bay during August 1986. ($\bar{x}$ = mean carapace length; SE = standard error; N = number of individuals).

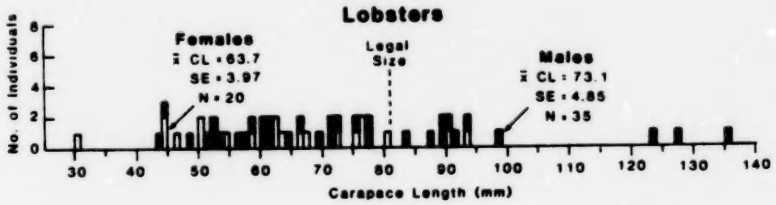

Fig. 9. Size frequencies of lobsters collected by divers in the northern half of St. Marys Bay during July 1986 (see Fig. 3 for diving locations). ($\bar{x}$ = mean carapace length; SE = standard error; N = number of individuals).

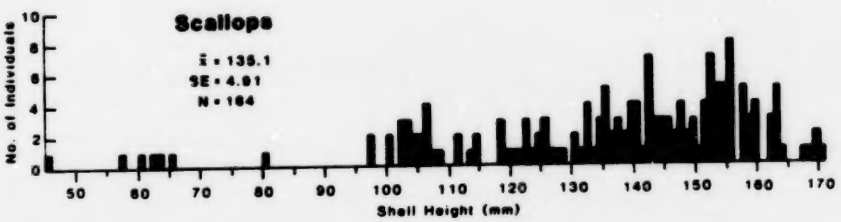

Fig. 10. Size frequencies of scallops collected on Mink Cove shoal by divers during July 1986 (see Fig. 3 for diving locations). ($\bar{x}$ = mean shell height; SE = standard error; N = number of individuals).

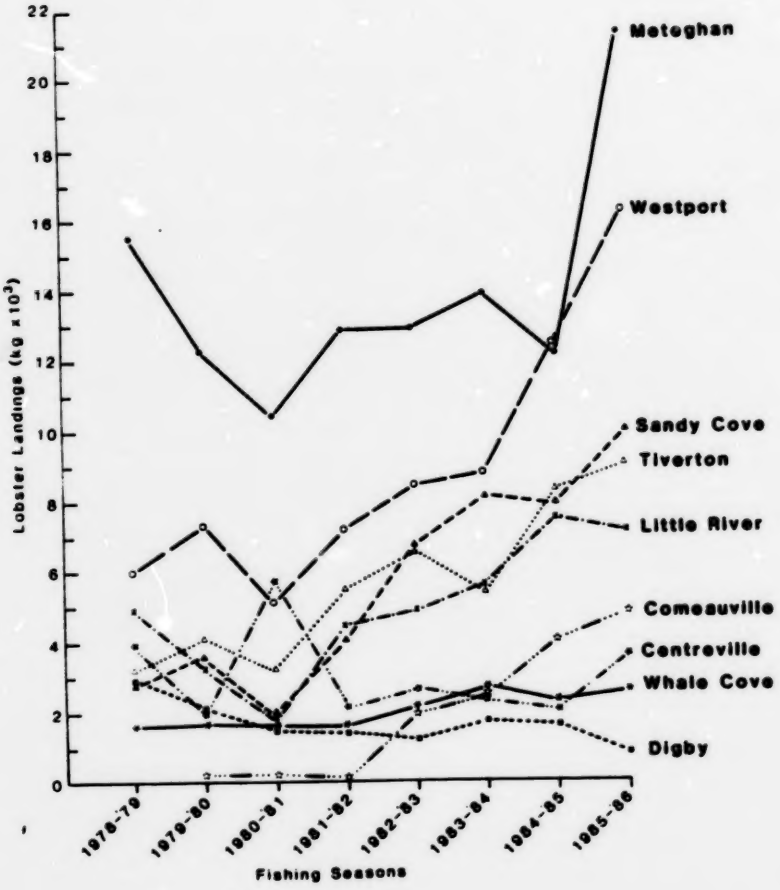

Fig. 11. Annual lobster landings (from 1978-79 to 1985-86 fishing seasons) for fishing ports throughout St. Marys Bay and surrounding areas (Digby and Whale Cove are located outside St. Marys Bay).

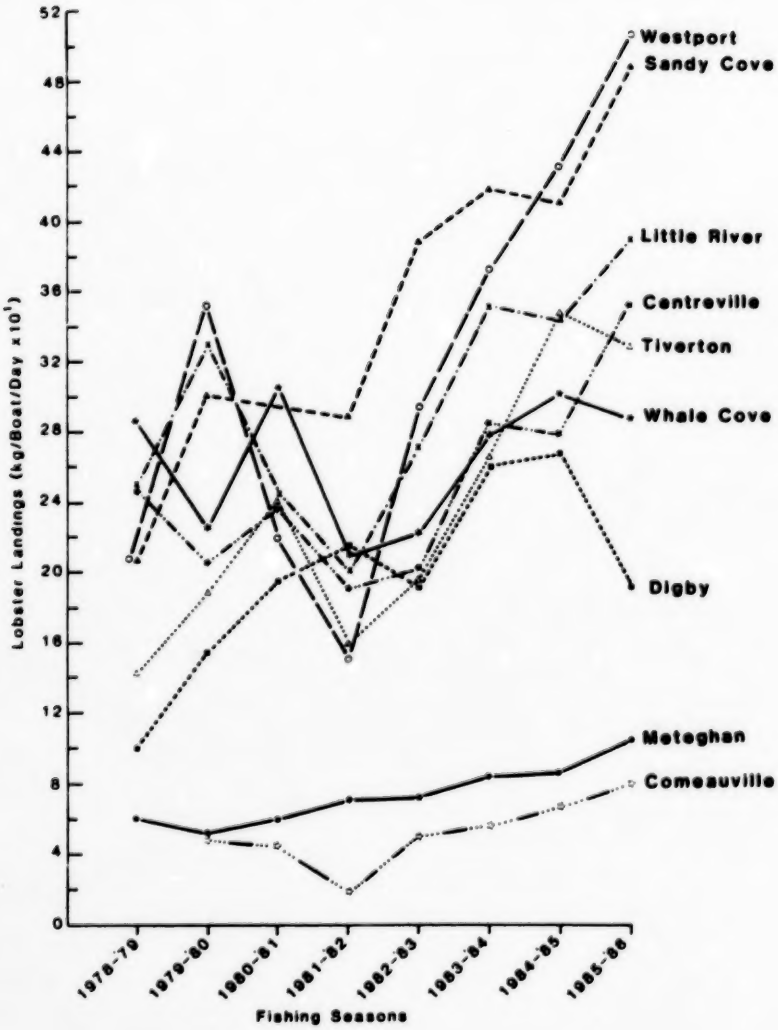

Fig. 12. Mean CPUE (kg/boat/day) from 1978-79 to 1985-86 fishing seasons for fishing ports throughout St. Marys Bay and surrounding areas. (Digby and Whale Cove are located outside St. Marys Bay).

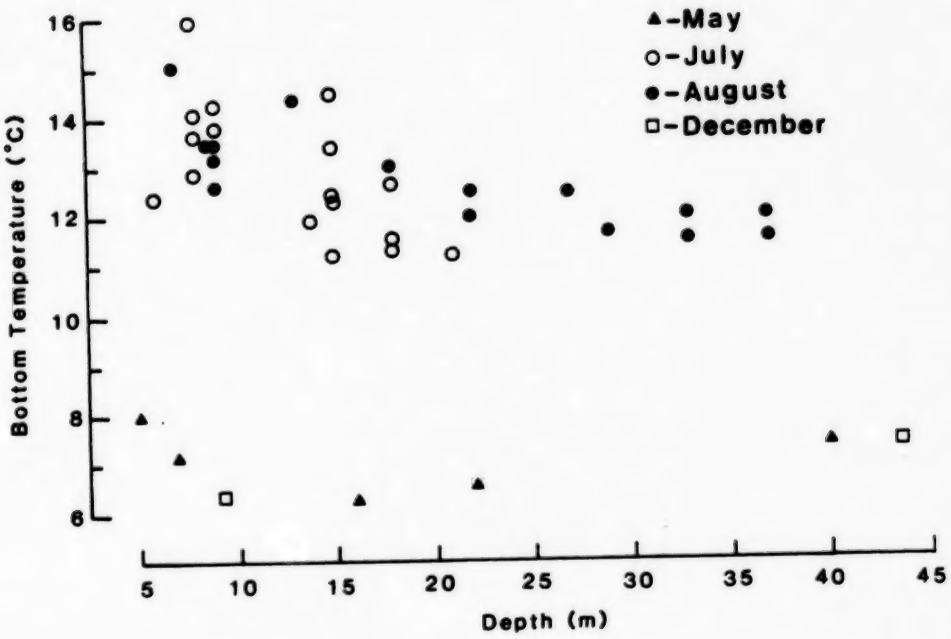

Fig. 13. Bottom water temperatures, throughout St. Marys Bay, according to depth (m) during 13-16 May, 14-19 July, 22-25 August and 1-2 December 1986.